HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program: NF Nooksack Native Chinook Restoration

Program (Kendall Creek Hatchery)

Species or

Hatchery Stock:

NF Nooksack River Chinook

Agency/Operator: Washington Department of Fish and Wildlife

Watershed and Region: NF Nooksack River

Puget Sound

Date Submitted: August 23, 2002

Date Last Updated: August 21, 2002

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Nooksack Native Spring Chinook Restoration Program

1.2) Species and population (or stock) under propagation, and ESA status.

North Fork Nooksack River Chinook (*Oncorhynchus tshawytscha*) - "threatened"

The original stock is an element of the Puget Sound Chinook ESU which has been listed under the Endangered Species Act (ESA) as threatened. The hatchery component of this stock has been listed as essential to the recovery of the stock.

1.3) Responsible organization and individuals

Name (and title): Chuck Phillips, Region 4 Fish Program Manager

Ted Thygesen, Nooksack Complex Manager

Agency or Tribe: Washington Department of Fish and Wildlife

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Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

The Lummi and Nooksack tribes, the US Fish and Wildlife Service, US Forest Service and Whatcom County have all contributed to this recovery program.

The Nooksack Chinook Technical Committee composed of members from WDFW, USFWS, US Forest Service and Lummi and Nooksack Tribes had been active in Nooksack River chinook restoration since about 1980. Additionally, the Nooksack Salmon Enhancement Association (NSEA), the Nooksack area Regional Fisheries Enhancement Group, has been actively involved in this program for the past 5 years by providing volunteers to feed fish at the acclimation ponds. Whatcom County has provided acclimation site maintenance and volunteer labor per diem.

1.4) Funding source, staffing level, and annual hatchery program operational costs.

Funding for this program is provided by the State General Fund, federal ESA Recovery Fund and Whatcom County.

1.5) Location(s) of hatchery and associated facilities.

Kendall Creek Hatchery: NF Nooksack River (01.0120) RM 46 at confluence

with Kendall Creek (01.0406), Puget Sound,

Washington

Deadhorse Creek Acclimation Pond: NF Nooksack River (01.0120) at the confluence with

Deadhorse Creek (01.0495) RM 63.5

Excelsior Creek Acclimation Ponds: NF Nooksack River (01.1020) at Excelsior Camp

Ground RM 65.1

* Kidney Creek Acclimation Pond: NF Nooksack River (01.0120) RM 55 on Canyon

Creek (01.0437) at the confluence with Kidney

Creek (01.0443) RM 5.3

Remote Site Incubation Locations: NF Nooksack River at RM 49.9 and 53

* currently not being used

1.6) Type of program.

Integrated Recovery

1.7) Purpose (Goal) of program.

Restoration

The goal of this program is to use indigenous stock to restore spring chinook salmon in the North Fork Nooksack River to a self-sustaining level of 2,000 natural-origin recruit spawners. This stock is also an indicator stock for North Fork Nooksack Spring Chinook. (Hatchery Scientific Review Group (HSRG), Nooksack/Samish Briefing Book, April 2002).

1.8) Justification for the program.

Driven by chronically low natural escapements, a restoration program for this locally indigenous stock was developed using a strategy of increasing the numbers of juveniles released and subsequently increasing the number of returning spawners. Recent numbers of natural-origin spawners have been extremely low which emphasizes the importance of the hatchery component of this program as a reservoir for the genome while limiting factors are being addressed.

WDFW and the tribes shall conduct the proposed program in such a way as to assure that the genetic, ecological and demographic effects on the listed chinook salmon in the Puget Sound region do not appreciably reduce the likelihood of the survival and recovery of the Puget Sound chinook ESU.

1.9) List of program "Performance Standards".

1.10) List of program "Performance Indicators", designated by "benefits" and "risks."

Performance Standards and Indicators for Puget Sound Integrated Recovery Chinook programs.

Performance Standard	Performance Indicator	Monitoring and Evaluation Plan
Produce adult fish for spawning escapement	Survival and return rates	Monitor catch and survivals using CWTs, escapement data
Meet hatchery production goals	Number of juvenile fish released - 150,000 onstation, 400,000 acclimation site, 200,000 Middle Fork, 50,000 RSI	Estimating number of fish planted (weighing / counting fish), monitoring proximity to hatchery production goals, number released recorded on Hatchery Division's "plants reports", data available on WDFW data base.
Manage for maximum escapement	Hatchery-origin and natural- origin return rates 2,000 natural-origin recruit spawners.	Monitoring hatchery / wild return rates through trapping (at the hatchery or at weir), redd and snorkel surveys on the spawning grounds, catch records

Minimize interactions with listed fish through proper	Total number of broodstock collected - ~500	Measure number of fish actually spawned to meet
broodstock management	Sex ratios and Age Composition	eggtake goal Hatchery records
	Timing of adult collection / spawning - collected throughout run prior to August 24	Trap fish throughout run, dates and times recorded on Hatchery Division's "adult reports", date available on
	Number of listed fish passed upstream - dependent on escapement to hatchery - all excess in 1:1 M:F ratio	WDFW database. Spawner survey data, CWT data
	Hatchery stray rate <4% inside GDU; dependent on acceptable risk profile <1% outside GDU	
	Number wild fish used in broodstock - to be determined, currently 0	
	Return timing of hatchery / wild adults - May thru September	
	Adherence to spawning guidelines- 2:2; male:female	
Minimize interactions with listed fish through proper	Juveniles released as smolts all except RSI evaluation	Future Brood Document
rearing and release strategies	Outmigration timing of listed fish / hatchery fish - prior to April 15th /after April 15th	Hatchery records CWT data
	Size and time of release 60 - 100 fpp/April-June	
Maintain stock integrity and	Effective population size	Spawning guidelines
genetic diversity	Monitor divergence of hatchery fish morphology and behavior characteristics	Spawner surveys
	HOR spawners	

Maximize in-hatchery survival of broodstock and their progeny; and Limit the impact of pathogens associated with hatchery stocks, on listed fish	Fish pathologists will monitor the health of hatchery stocks on a monthly basis and recommend preventative actions / strategies to maintain fish health	Follow Co-Manager's
	Fish pathologists will diagnose fish health problems and minimize their impact	Disease Policy
	Vaccines will be administered when appropriate to protect fish health	Fish Health exam reports
	A fish health database will be maintained to identify trends in fish health and disease and implement fish health management plans based on findings	
	Fish health staff will present workshops on fish health issues to provide continuing education to hatchery staff.	
Ensure hatchery operations comply with state and federal water quality standards through proper environmental monitoring	NPDES compliance	Monthly NPDES reports

1.11) Expected size of program.

1.11.1) Proposed annual broodstock collection level (maximum number of adult fish).

Until 2000, all returning adult Nooksack chinook were used for broodstock. In 2000, excess adults were transported back to the Nooksack River to spawn naturally. Starting in 2002, approximately 500 adults will be need for broodstock (Eggtake goal of 855,000) Maximum number of adults varies according to year class. Fecundity ranges from 3500 eggs for 3 year olds to 5200 for 5 year olds.

WDFW and the co-managers will work with the NMFS Science Branch to develop protocols using the best available science for the use of available hatchery returns in excess to the requirements of the program. These protocols will address the selection of broodstock in a manner which closely mimics the age distribution of natural spawning population and maintains/increases the natural diversity of the naturally spawning population.

1.11.2) Proposed annual fish release levels (maximum number) by life stage and location.

Life Stage	Release Location	Annual Release Level
Eyed Eggs		
Unfed Fry	Upper NF Nooksack basin (01)	50,000
Fry		
Fingerling	Kendall Creek (01.0406) NF Nooksack watershed (01) including DeadHorse Pond and/or Excelsior side channel and tributary pond	*150,000 400,000
	MF Nooksack	200,000
Yearling	see Note: below	

Note: Yearling releases were discontinued in 1998 (96 BY).

1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.

For 1988 to 1995, the smolt to adult survival rates ranged between .038 to 1.473% (Avg. is .412% from coded-wire tag data base (RMIS)).

1.13) Date program started (years in operation), or is expected to start.

1981

1.14) Expected duration of program.

Ongoing

^{*-}Program production/release strategies have been re-evaluated and decreased from 600,000 to 400,000 to 150,000 on-station release. 200,000 to be planted in the MF Nooksack (2002)

1.15) Watersheds targeted by program.

NF and MF Nooksack River (01.0120; 01.0339)

1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.

There is a significant effort underway to identify factors limiting the survival (in the freshwater environment) of natural-origin spawners in the North Fork Nooksack River. Starting with 2002 brood, the hatchery component of this program will be scaled back. WDFW and the co-managers will consult with NMFS to determine the protocols for utilizing the hatchery production in a manner which most efficiently promotes the recovery of the natural spawning population. This will be done while maintaining sufficient reserves of hatchery broodstock to ensure protection against sudden reversals in natural spawning population survival.

Funds have been lacking to look at what the limiting factors may be in early marine survival of Nooksack spring chinook.

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS.

2.1) List all ESA permits or authorizations in hand for the hatchery program.

None.

- 2.2) Provide descriptions, status, and projected take actions and levels for ESA-listed natural populations in the target area.
 - 2.2.1) Description of ESA-listed salmonid population(s) affected by the program.
 - Identify the ESA-listed population(s) that will be directly affected by the program.

Puget Sound Chinook and Bull Trout/Dolly Varden. Three stocks of chinook are identified in the Nooksack basin. They are North Fork Nooksack Chinook, South Fork Nooksack Chinook, and Samish, Mainstem Nooksack Fall Chinook. The first two are of native origin and the health of the populations as per SASSI is considered "critical". The third is an introduced hatchery stock. Its status is "unknown".

Native chinook enter the Nooksack from April through early September. Spawning occurs in August and September. Outmigration of juveniles occurs in the spring.

Three stocks of native char have been identified in the Nooksack basin. These are the Lower Nooksack, Canyon Creek and Upper Middle Fork stocks. The latter is isolated from the rest of the basin due to a diversion dam. The USFWS is supportive of laddering the dam to provide passage. Char exhibit anadromous, fluvial, and resident life histories. Spawning occurs in the fall. After spawning, anadromous adults move downriver and enter the estuary during the spring while fluvial adults disperse throughout the upper river. Subadults may also enter the river from the estuary in late winter and early spring. Adults return to spawning staging areas in late summer.

There are no data on char population sizes and the status of the stocks is unknown.

- Identify the ESA-listed population(s) that may be <u>incidentally</u> affected by the program.

Bull Trout/Dolly Varden

- 2.2.2) Status of ESA-listed salmonid population(s) affected by the program.
- Describe the status of the listed natural population(s) relative to "critical" and "viable" population thresholds

Critical and viable population thresholds under ESA have not been determined yet, however, the SASSI report (1994) determined that the NF and SF chinook are "critical". Dolly Varden/Bull Trout are "unknown".

- Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.

For the North Fork, wild / hatchery ratio for 1995 to 1999 = .31:1 average (range 3.3:1 to .11:1). The recruit / spawner ratio range for 1995 to 1999 = .00000 to .53333 fish per spawner.

There is limited data for the South Fork wild/hatchery ratios in these categories. (Pete Castle, Area Biologist, WDFW)

- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

ESTIMATED ESCAPEMENT OF NOOKSACK CHINOOK STOCKS

YEAR	SOUTH FORK	NORTH FORK
	CHINOOK	CHINOOK
1984	188	45
1985	445	255
1986	170	224
1987	248	179
1988	233	452
1989	606	300
1990	142	10
1991	365	107
1992	103	493
1993	235	445
1994	118	45
1995	290	228
1996	203	538
1997	180	621
1998	157	366
1999	213	892
2000	283	1,242
2001	264	6,950*

^{* -} Does include the 4,765 hatchery "putbacks" to the NF Nooksack.

Note: In 1999 and 2000, 55.6% and 32.4%, respectively, of the carcasses surveyed in the SF Nooksack were strays from the NF Nooksack Kendall stock rebuilding program (Ned Currencies, Nooksack tribal biologist, personal communication).

- Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

Year	NOR's	HOR's	% of Natural Origin on NF
1995	175	53	76.1
1996	210	328	39.3
1997	121	500	19.6
1998	39	327	10.5
1999	91	801	10.2
2000	160	1,082	12.6
2001	240	6,950*	3.5

^{* -} Does include the 4,765 hatchery "putbacks" to the NF Nooksack.

- 2.2.3) Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of listed fish in the target area, and provide estimated annual levels of take (see "Attachment 1" for definition of "take").
- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.

Broodstock Collection - Returning hatchery fish are trapped during the entire run period. In the past, all returning adults were killed and spawned to meet the program goals for the restoration program. It is necessary to trap during the entire run to maintain the proper genetic diversity of the restored stock. More recently, excess adults have been returned to the river to spawn naturally. Recent discussions with the Lummi and Nooksack tribes have focused on disposition of adults excess to the program needs, should they occur. Starting in 2002, excess adults will be trucked and released into Canyon Creek and the Middle Fork Nooksack. A 1:1 male to female ratio will be maintained and any excess males beyond these pairings will be killed and utilized by the tribes or used for nutrient enhancement.

To date no naturally produced Nooksack chinook have returned to the hatchery to be used as broodstock.

Juvenile releases - There are potential take issues of hatchery reared chinook competing with or preying on naturally produced juvenile chinook. The extent of these issues is unknown. However, hatchery reared fish are released as smolts (to minimize outmigration time) and after the naturally produced chinook have outmigrated (to minimize freshwater predation and competition).

Facility issues - While there is a hatchery rack on Kendall Creek, no chinook are passed upstream. Screens on the Kendall Creek intake are currently not in compliance with state and federal standards. Since there is no chinook production above the rack on Kendall Creek, there is no associated take.

Straying of North Fork chinook into the South Fork - The recent reduction in the size of the hatchery program, especially the Kendall Creek on-station release (600,000 to 400,000 to 150,000) should dramatically reduce strays into the South Fork. Reductions in numbers of chinook released from acclimation sites located in the upper river should also reduce strays into the South Fork.

- Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.

To date, there have been no natural-origin volunteers trapped and spawned for broodstock. The take of the listed spring chinook is associated with the trapping, spawning, incubation and rearing of the listed species. See 7.4.2 for additional information.

Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).

See "take" table at the end of the HGMP.

- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

If adult, egg, fry or fingerling losses begin to exceed normal levels, appropriate corrective measures will be applied. NMFS will be notified if and when the recovery program is expected to exceed the take in any category.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. *Hood Canal Summer Chum Conservation Initiative*) or other regionally accepted policies (e.g. the NPPC *Annual Production Review* Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

None.

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.

All acclimation sites are on USFS lands and are accessable via an annual access permit. Dead Horse Pond was built by the Nooksack Tribe.

Consistent with Puget Sound Salmon Management Plan.

3.3) Relationship to harvest objectives.

There is no directed harvest in the terminal area, however, there is a restricted sport fishery in mixed stock areas. The predicted overall exploitation rate in all 2000 fisheries upon Nooksack spring chinook is 13% and the exploitation rate in southern U.S. fisheries is 4%.

3.3.1) Describe fisheries benefitting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.

Although there is no directed harvest in the terminal area, there are fisheries (below) that benefit from the program (see above). The objective of the program is to recover the stock so that fisheries can benefit. The fisheries management objective is to minimize the impact of incidental harvest to a level that does not impede recovery. Catch is incidental in the Puget Sound sport fishery (<4%), net fishery (<2%), and Canadian fisheries (<10%).

3.4) Relationship to habitat protection and recovery strategies.

Hatchery production is supplementing natural production while efforts for habitat recovery programs are on-going. There is a significant effort underway to identify factors limiting the survival of natural-origin spawners in the North Fork Nooksack River. As habitat recovers, and natural spawners become productive, the hatchery component of this program will be scaled back accordingly. WDFW and the co-managers will consult with NMFS to determine the protocols for scaling back the hatchery production in a manner which most efficiently promotes the recovery of the natural spawning population. This will be done while maintaining sufficient reserves of hatchery broodstock to ensure protection against sudden reversals in natural spawning population survival. A Watershed Recovery Plan is being developed and this program is an essential factor in this plan.

3.5) Ecological interactions.

Risk of predation/competition of/with wild smolts is low since they are released at a size that mimics indigenous, wild smolt outmigration.

SECTION 4. WATER SOURCE

4.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.

Nooksack chinook are reared at Kendall Creek on well water that is a constant 47° F. The rearing at Kendall Creek is under the NPDES permit WAG-133007. At the acclimation sites the surface water is used from the respective sources. Adults are held on well water at Kendall Creek. Kendall Creek is a seasonal stream that goes dry in the summer. It does run in the spring , however, it is not possible to get the water to the spring chinook ponds. Additionally, the creek is dry during the time the adult spring chinook are returning and is therefore not available as attraction water. Well water is discharged into Kendall Creek as attraction water.

Several Remote Site Incubators (RSIs) have been operated in recent years (1998 and 1999 broods) on un-named springs and a municipal water source between RM 49.9 and 53.

4.2) Indicate risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.

The Kendall Creek gravity intake does not have compliant intake screens. These screens are identified for replacement but are a lower priority than others since listed chinook are not passed above the rack on Kendall Creek. (the creek is dry during the time the adult spring chinook are returning).

Kendall Creek conducts effluent monitoring and reporting under the NPDES permit WAG-133007.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

Fish are collected at the Kendall Creek Hatchery holding pond. Returning adults enter the ladder from Kendall Creek and hold in the pond.

5.2) Fish transportation equipment (description of pen, tank truck, or container used).

Adults are transported from the holding pond to the raceways using a 4'X4X3' deep plastic tote. Adults are placed in the tote by hand. The tote of fish is transported to the raceways by tractor where the fish are taken out of the tote by hand and placed in the raceway. The adults are held in the raceways until spawning.

5.3) Broodstock holding and spawning facilities.

Broodstock are held in 100' X 10' raceways. Fish are segregated by entry date to facilitate proper erthromycin innoculation.

5.4) Incubation facilities.

Eggs are incubated in vertical incubators using well water.

5.5) Rearing facilities.

Fish are reared in 100' X 10' raceways using well water.

5.6) Acclimation/release facilities.

Fish are released from the raceways into Kendall Creek: Deadhorse Pond is a 1/4 acre asphalt pond; Kidney Creek is a 1/4 acre dirt pond; Excelsior tributary pond is a series of small ponds; and Excelsior side channel is a temporary pond made in a side channel of the NF Nooksack River.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.

Adult chinook are collected and segregated on a weekly basis for the purpose of erythromycin innoculation for Bacterial Kidney Disease. Each fish requires up to 3 seperate innoculations during the holding and maturation period. The adult trap has no capacity to segregate the returnees by week and therefore they must be moved into standard rearing raceways until they are spawned. In some years this results in a high loss of males, apparently due to multiple handlings required to transfer them into the rearing ponds. Losses have ranged from a few percent to as high as 12%. This has not affected the overall spawning operations as males are generally in surplus to females. WDFW will seek funding to provide segregation capacity, in the adult trap / holding pond, to minimize handling stress and possible loss, due to handling fish.

5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

The hatchery will be staffed full-time and equipped with a low-water alarm system to help prevent catastrophic fish loss resulting from water system failure. At Kendall Creek a generator and backup well pumps are available. A Fish Health Specialist monitors the health of the fish and prescribes proper treatment to minimize loss. There are no backup power or water sources at the acclimation sites as their water comes via natural gravity sources.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

Describe the origin and identity of broodstock used in the program, its ESA-listing status, annual collection goals, and relationship to wild fish of the same species/population.

6.1) Source.

Broodstock are collected from volunteer chinook returning to trap at Kendall Creek Hatchery. These fish are from indigenous Nooksack Spring Chinook reared and released at Kendall Creek and acclimation sites. Broodstock are no longer collected from the spawning grounds.

6.2) Supporting information.

6.2.1) History.

Initial attempts to establish a spring chinook hatchery program at Kendall Creek used a variety of local and non-local stocks. Most recently, Solduc stock chinook was released into Kendall Creek. These plants were:

1975 80,000 smolts 1976 123,450 smolts 1978 113,000 smolts 1981 80,000 smolts

It is unknown how or to what extent past introductions affected the genetic integrity of the native spring chinook in the Nooksack River basin.

The present program began in 1981 utilizing the NF Nooksack Spring Chinook stock. Adults were gillnetted in Wicks Slough, a clearwater branch near the hatchery, and transferred to the hatchery for holding and spawning to establish an adult return to Kendall Creek. From CWT data (1988-present), no other stocks have been found to have strayed (and incorporated) into the Kendall Creek hatchery broodstock.

6.2.2) Annual size.

Currently, 500 adults are needed for broodstock (see Section 1.11.1).

6.2.3) Past and proposed level of natural fish in broodstock.

The restoration program was started with natural origin fish from the North Fork Nooksack River. Since then, the program has relied totally on volunteer returns to the hatchery. In the past, hatchery/wild fish were not entirely differentiated with distinguishing marks so it was possible that wild fish contributed to the broodstock at some level. All hatchery fish are now identified with a coded-wire tag or otolith mark. All spring chinook spawned in recent years have been of hatchery-origin.

Fish arriving after August 23rd are not used in the spawning population because they may be fall chinook. The hatchery propagation of the indigenous Nooksack Chinook will enhance the total Nooksack River chinook returns and prevent possible extirpation of this "critical", native stock.

6.2.4) Genetic or ecological differences.

There is no known differences between the natural and hatchery maintained chinook.

6.2.5) Reasons for choosing.

This is an indigenous stock. The adults collected are selected for spawning only if they have been identified as NF Nooksack chinook through the proper otolith mark or codedwire tag. Each potential hatchery spawner is positively identified via coded-wire tag recovery or otolith band analysis.

6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.

The RSI and acclimation pond fish are otolith marked as sac-fry. Each release group is uniquely marked. When returning fish are spawned, their otoliths are excised and read. To ensure genetic purity, only fish that are identified as Nooksack Spring Chinook by the otolith mark are selected for spawning. Coded-wire tags are applied to all 150,000 of the fingerlings that are released on-station. The CWTs are read in place of reading the otolith mark. Adult spawners are selected randomly and propagated from the entire run timing prior to August 24th.

SECTION 7. BROODSTOCK COLLECTION

7.1) Life-history stage to be collected (adults, eggs, or juveniles).

Adults

7.2) Collection or sampling design.

Adults are captured by a weir trap on Kendall Creek. They enter the holding pond via a fish ladder. A finger weir is used to keep the adults from escaping the holding pond. Broodstock collection occurs from May to September. All chinook trapped during this period are held for broodstock consideration.

7.3) Identity.

The method for identifying the target population is the use of otolith marks and coded-wire tags. These fish are genetically the same as the naturally produced fish. Only chinook volunteering into the hatchery trap prior to September 21 will be considered for spawning. All eggs from adults spawned prior to August 24 will be used. After that date, and until September 21st, only eggs from positively identified hatchery-origin Nooksack spring chinook will be used.

7.4) Proposed number to be collected:

7.4.1) Program goal (assuming 1:1 sex ratio for adults):

Program egg take goal is 855,000. The number of adults vary because of the fecundity difference among 3, 4 and 5 year old fish. For example, in 1998 most of the females returning were 4 year olds; 192 females were needed to produce 1,000,000 eggs. In 1999 most of the females were 3 year olds which meant 263 females were required to produce 1,000,000 eggs. Currently, the number of adults needed for broodstock is approximately 500.

7.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

Year	Males	Fema les	Jacks	Eggs	Juveniles
1988	411	426	979	2,043,460	
1989	186	284	54	1,337,600	
1990	34	74	13	200,324	
1991	111	40	179	198,944	
1992	638	378	258	1,424,395	
1993	661	703	58	1,893,100	
1994	301	249	77	489,900	
1995	521 (105)	271 (78)	299 (2)	265,220	
1996	760 (289)	310 (286)	131 (3)	1,004,950	
1997	1,100 (479)	563 (480)	16	1,913,180	
1998	662 (532)	616 (576)	35 (2)	2,969,200	
1999	2,301 (539)	572 (535)	26 (1)	2,060,700	
2000	1,396 (588)	652 (585)	45 (3)	2,303,000	
2001	3,922 (486)	1,440(489)	450 (4)	1,956,000	

Note: Numbers in parentheses are adult broodstock totals. Actual adults returning to hatchery are to the left of the broodstock numbers.

7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.

WDFW and the co-managers will work with the NMFS Science Branch to develop protocols using the best available science for the use of available hatchery returns in excess to the requirements of the program. These protocols will address the selection of broodstock in a manner which closely mimics the age distribution of natural spawning population and maintains/increases the natural diversity of the naturally spawning population. In recent years all excess broodstock have been returned to the river to spawn naturally. Starting in 2002, excess adults, maintaining a 1:1 male to female ratio, will be trucked to Canyon Creek and the Middle Fork Nooksack. The numbers (not to exceed carrying capacity) and priority for the sites will be determined by the Co-managers. Any additional excess males will be killed and utilized by the tribes or used fro nutrient enhancement.

7.6) Fish transportation and holding methods.

Chinook are transported weekly from the trap to 10' x 100' raceway ponds for holding until spawning. Each fish is removed from the trap using a dip net with soft webbing, length is recorded and a Floy tag is applied to indicate week of return. Each fish is inoculated for bacterial Kidney Disease (BKD), and placed by hand into a 4' X 4' X 3' high plastic tote. Each tote is used to transport 15 fish at a time. Fresh water is circulated through the totes during the entire process which takes approximately 15 minutes.

Chinook are initially segregated by run time to facilitate secondary and tertiary BKD inoculations. They are later segregated by sex as males are more prone to prespawning mortality due to handling. The raceways are covered with tarped areas to protect the fish from the sun. If surplus adults are hauled to upriver spawning sites, rubber tubes will be used to transport the fish to the transport truck. The trucks have oxygen and aerators.

7.7) Describe fish health maintenance and sanitation procedures applied.

Consistent with Co-Managers Salmonid Disease Control Policy

7.8) Disposition of carcasses.

All fish spawned have been buried because of the use of erythromycin. These may be used for nutrient enhancement in the future. Non- injected (erythromycin) fish could go to the tribes, food banks or be used for nutrient enhancement.

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.

See section 5.7

Only known hatchery-origin or wild volunteer Nooksack Spring Chinook are used for broodstock. Wild-origin broodstock are no longer collected on the spawning grounds. See 6.2.5 for additional information.

Broostock collection is conducted consistent with Co-Managers Salmonid Disease Control Policy.

SECTION 8. MATING

Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.

8.1) Selection method.

Fish are randomly chosen from ripe fish on spawning days. Spawning occurs once per week.

8.2) Males.

Sperm from two males is used fertilize the eggs from two females Jacks are spawned at the rate of 2% each week of spawning. On occasion, in the early part of the spawning season, there are insufficient ripe males and, as a consequence, the ratio of males to females may be less than 1:1. Normally, males are not used twice.

8.3) Fertilization.

For chinook arriving prior to August 24:

Fish are selected at random and mated in pairs (1:1). After fertilization eggs are pooled. Coded-wire tags or otoliths are collected from all fish to allow reading at a later date.

For chinook arriving after August 24:

Males and females are spawned individually and gametes are held separately, in coolers until otoliths or CWTs are read to ensure positive identification, then fertilized as above.

8.4) Cryopreserved gametes.

No cyropreservation.

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

Mates are chosen randomly from all ripe fish; fish spawned represent the entire run timing prior to August 24th.

SECTION 9. INCUBATION AND REARING -

Specify any management *goals* (e.g. "egg to smolt survival") that the hatchery is currently operating under for the hatchery stock in the appropriate sections below. Provide data on the success of meeting the desired hatchery goals.

9.1) Incubation:

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.

See 7.4

Green egg to fry survival is 86 to 93% (Avg. 90.7%).

9.1.2) Cause for, and disposition of surplus egg takes.

To date no surplus has occurred. All eggs are utilized in this program.

9.1.3) Loading densities applied during incubation.

Vertical incubators are used. Flow is 3 gallons per minute (gpm) for each stack of eight trays. Maximum loading is 8,000 eggs per tray.

9.1.4) Incubation conditions.

Eggs are incubated in well water. The water temperature is a constant 47°F. Dissolved oxygen is monitored and minimum criteria is 8 parts per million (ppm). Chillers are used to lower the water temperature to create otolith marks.

9.1.5) Ponding.

Ponding is forced. Each egg take is monitored using KD factor. The appropriate range is 1.97 - 2.04. This is approximately 1800 Temperature Units (TU's).

9.1.6) Fish health maintenance and monitoring.

Formalin is delivered via drip method from a closed system, to treat eggs for fungus. Egg mortality is removed prior to hatching. Vexar substrate is used to improve egg developement.

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.

Eggs are incubated in well water. Siltation is not a factor. There are low flow alarms on incubators.

9.2) Rearing:

9.2.1) Provide survival rate data (average program performance) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available..

Fry to smolt goal is 90%. Range is 89.9 to 97.5%.

9.2.2) Density and loading criteria (goals and actual levels).

Fish are reared at flow indexes of less then 2.07 at 47°F and density indexes of less than 0.3.

9.2.3) Fish rearing conditions

Fish are reared on well water at a constant 47°F. Dissolved oxygen is monitored to assure levels are above 8 ppm. Ponds are vacuumed weekly.

9.2.4) Indicate biweekly or monthly fish growth information (average program performance), including length, weight, and condition factor data collected during rearing, if available.

Not available.

9.2.5) Indicate monthly fish growth rate and energy reserve data (average program performance), if available.

Not available.

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (average program performance).

Fish are started on Bio-Oregon Biodiet then fed Biomoist feeds until released. This may change as feed products improve. Feeding rate is 2 to 3% body weight /day and the pounds of feed fed/day/gpm pond flow is kept below .15 lbs/gpm/day.

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.

Consistent with Co-Managers Salmonid Disease Control Policy

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.

Not applicable.

9.2.9) Indicate the use of "natural" rearing methods as applied in the program.

None used at Kendall Creek Hatchery. Working to identify modification to rearing methods which might produce fish at release that are closer to natural origin spawned juveniles in behavior and size.

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.

Fish are reared to fingerling smolt size (zeros) to mimic the natural fish size at outmigration. Fish are released no later then the first week of June during their first year.

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

10.1) Proposed fish release levels.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs				
Unfed Fry	50,000	1,200	March	NF Nooksack
Fry				
Fingerling	550,000	60 - 100	April 15 - May 31	NF Nooksack
	200,000	60 - 100	April - June	MF Nooksack
Yearling				

10.2) Specific location(s) of proposed release(s).

Stream, river, or watercourse:

Release point:

Kendall Creek Hatchery: NF Nooksack River (01.0120) RM 46 at confluence

with Kendall Creek (01.0406), Puget Sound,

Washington

Deadhorse Creek Acclimation Pond: NF Nooksack River (01.0120) at the confluence with

Deadhorse Creek (01.0495) RM 63.5

Excelsior Creek Acclimation Ponds: NF Nooksack River (01.1020) at Excelsior Camp

Ground RM 65.1

*Kidney Creek Acclimation Pond: NF Nooksack River (01.0120) RM 55 on Canyon

Creek (01.0437) at the confluence with Kidney

Creek (01.0443) RM 53

MF Nooksack: MF Nooksack River (01.0339).

Miscellaneous Remote Site Incubators at RM 49.9 and 53 on un-named springs and municipal water supply.

Major watershed: Nooksack River (01.1020)

Basin or Region: Puget Sound

^{*} not currently being used

10.3) Actual numbers and sizes of fish released by age class through the program.

Release Year	Eggs/ Unfed Fry	Avg size	Fry	Avg size	Fingerling	Avg size	Yearling	Avg size
1988							90,841	8 fpp
1989					1,142,520	75 fpp	94,266	7 fpp
1990					545,817	87 fpp	376,792	7 fpp
1991							346,632	8 fpp
1992							173,200	8 fpp
1993					871,091	76 fpp	170,900	6 fpp
1994					1,077,826	88 fpp	292,300	5 fpp
1995					193,145	104 fpp	347,450	8 fpp
1996					2,638	96 fpp	185,962	7 fpp
1997					755,453	82 fpp	187,765	10 fpp
1998			135,000	850 fpp	1,614,857	78 fpp	187,636	6 fpp
1999	142,458	1300 fpp			2,303,700	92 fpp		
2000					1,487,800	76 fpp		
2001					1,647,300	72 fpp		
Average					1,058,377	84 fpp	204,500	7 fpp

10.4) Actual dates of release and description of release protocols.

At Kendall Creek, the fish are normally released between April 15 and June 1. The fish are released as they attain the desired minimum release size of 100 fish per pound (fpp). Later releases are frequently characterized by fish of a larger size. If possible, the fish are released during a freshet. All releases from Kendall Creek are forced. Release dates from the acclimation ponds are scheduled to occur after the departure of wild-origin fingerling chinook in the area. USFWS pre-recovery-project assessment showed that, by April 15, most of the wild-born chinook fingerlings had migrated out of the acclimation site reaches and were progressing down river (USFWS 1982, Bob Wonderlake, pers. comm. via Doug Huddle). The acclimation site releases are scheduled to begin after that date and continue until June 1. Releases from the acclimation ponds are volitional.

Releases from the Remote Site Incubators (RSIs) are volitional and begin in December and progress through February. Releases are water temperature dependent. In 1998, due to a water problem at the RM 53 remote site, fry were returned to Kendall Creek for incubation and short-term rearing. They were then returned to the site for acclimation and release.

10.5) Fish transportation procedures, if applicable.

Fish are transported in 300 and 800 gallon tanks (250 and 675 pounds of fish, respectively). Each truck is equipped with circulation pumps and oxygen stones. Oxygen levels are monitored. Transit time to the acclimation sites is 1 hour or less. Fish size is 90 to 100 fpp.

10.6) Acclimation procedures

Fish are trucked to Excelsior and Dead Horse ponds for acclimation and release. At these sites, fish are acclimated (de-stressed) for 3 days. The Excelsior tributary ponds can accommodate only 50,000 fish at a time. 4 groups of fish are acclimated there. DeadHorse and Kidney Creek can accommodate 200,000 fish each.

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

All chinook in the program receive otolith marks unique to their release group. In addition, the 400,000 fish released at Excelsior and/or Deadhorse are coded-wire tagged as a double-index (DIT) group. (200,000 fish receive an adipose fin clip and a coded-wire tag and the other 200,000 fish receive just the coded-wire tag). MF Nooksack releases will be coded-wire tagged only. All broodstock returning to the hatchery will have their coded-wire tags and otoliths read to maintain separation between spring and fall chinook stocks. WDFW should monitor chinook escapement to the Nooksack River sites to estimate the number of tagged, untagged and marked fish escaping to the river each year. This monitoring will allow for assessment of the status of the target population and the success of the program in achieving restoration objectives.

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

Every effort will be made to take only enough eggs to meet program needs. Minor numbers of excess eggs could be utilized in the RSI program.

10.9) Fish health certification procedures applied pre-release.

Fish are monitored by fish health specialist prior to release.

10.10) Emergency release procedures in response to flooding or water system failure.

Flooding is not a problem at Kendall Creek. Water system failure is backed up by generators and creek water.

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

All spring chinook sub-yearlings are released while smolting to insure proper migration to the estuary. Releases from RSI's allow the fish to grow, smolt and outmigrate with the naturally produced fish.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

11.1) Monitoring and evaluation of "Performance Indicators" presented in <u>Section 1.10.</u>

Note: See section 1.10 for Monitoring and Evaluation. The purpose of a monitoring program is to identify and evaluate the benefits and risks which may derive from the hatchery program. The monitoring program is designed to answer questions of whether the hatchery is providing the benefits intended, while also minimizing or eliminating the risks inherent in the program. A key tool in any monitoring program is having a mechanism to identify each hatchery production group.

Each production group shall be identified with distinct otolith marks, adipose clips, coded wire tags, blank wire tags or other identification methods as they become available, to allow for evaluation of each particular rearing and/or release strategy. This will allow for selective harvest on hatchery stocks when appropriate, monitoring of interactions of hatchery and wild fish wherever they co-mingle in riverine, estuarine and marine habitats and assessment of the status of the target population. WDFW shall monitor the Chinook salmon escapement into the target and non-target Chinook populations to estimate the number of tagged, un-tagged and marked fish escaping into the river each year and the stray rates of hatchery Chinook into the rivers.

11.1.1) Describe plans and methods proposed to collect data necessary to respond to each "Performance Indicator" identified for the program.

Continue to coded-wire tag and otolith mark fish to allow identification at the hatchery rack and on the spawning grounds. All broodstock returning to the hatchery will have their coded-wire tags and otoliths read to maintain separation between spring and fall chinook stocks. WDFW should continue to monitor chinook escapement to the NF and SF Nooksack River to estimate the number of tagged, untagged and marked fish escaping or straying to the river each year. This monitoring will allow for assessment of the status of the target population and the success of the program in achieving restoration objectives.

11.1.2) Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.

Funding and resources are currently committed to monitor and evaluate this program as detailed in the Resource Management Plan for Puget Sound Chinook Salmon Hatcheries (Washington Department of Fish and Wildlife and Puget Sound Treaty Tribes, August 23, 2002).

11.2) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.

Every attempt will be made to monitor and evaluate this stock in a manner which does not negatively effect listed species.

SECTION 12. RESEARCH

There is currently no research being conducted on Nooksack Spring Chinook

- 12.1) Objective or purpose.
- 12.2) Cooperating and funding agencies.
- 12.3) Principle investigator or project supervisor and staff.
- 12.4) Status of stock, particularly the group affected by project, if different than the stock(s) described in Section 2.
- 12.5) Techniques: include capture methods, drugs, samples collected, tags applied.
- 12.6) Dates or time period in which research activity occurs.
- 12.7) Care and maintenance of live fish or eggs, holding duration, transport methods.
- 12.8) Expected type and effects of take and potential for injury or mortality.
- 12.9) Level of take of listed fish: number or range of fish handled, injured, or killed by sex, age, or size, if not already indicated in Section 2 and the attached "take table" (Table 1).
- 12.10) Alternative methods to achieve project objectives.
- 12.11) List species similar or related to the threatened species; provide number and causes of mortality related to this research project.
- 12.12) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse ecological effects, injury, or mortality to listed fish as a result of the proposed research activities.

SECTION 13. ATTACHMENTS AND CITATIONS

Hatchery Scientific Review Group (HSRG), Nooksack/Samish Briefing Book, April 2002.

Piper, Robert, et. al., 1982, Fish Hatchery Management; United States Dept of Interior, Fish and Wildlife Service, Washington, DC.

Seidel, Paul. 1983. Spawning Guidelines for Washington Department of Fish and Wildlife Hatcheries. Washington Department of Fish and Wildlife, Olympia.

Washington Department of Fish and Wildlife. 1996. Fish Health Manual. Hatcheries Program, Fish Health Division, Washington Department of Fish and Wildlife, Olympia.

Washington Department of Fish and Wildlife and Puget Sound Treaty Tribes, 2002, "Puget Sound Chinook Salmon Hatcheries, Resource Management Plan", a component of Comprehensive Chinook Salmon Management Plan, August 23, 2002. 103 pages.

SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the foregoing information is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973."

Name, Title, and Signature of Applicant:	
Certified by	Date:

Table 1. Estimated listed salmonid take levels of by hatchery activity.

Listed species affected: Nooksack Chinook ESU/Population: N. Fork Nooksack River Activity: Chinook Restoration Location of hatchery activity: Kendall Creek Dates of activity: ongoing Hatchery program operator: Ted Thygesen Annual Take of Listed Fish By Life Stage (Number of Fish) Type of Take Egg/Fry Juvenile/Sm olt Adult Carcass Observe or harass a) Collect for transport b) 0 to 3,000 Capture, handle, and release c) Capture, handle, tag/mark/tissue sample, and release d) Removal (e.g. broodstock) e) Intentional lethal take f) up to 1000 Unintentional lethal take g) Inc. loss 7-14% Rearing loss 2 ½ 150 to 450 pre-59,000 to to 10% 21,000 to spawning loss

- a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.
- b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
- c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
- d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.

85,000 fish

120,000

- e. Listed fish removed from the wild and collected for use as broodstock.
- f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
- g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
- h. Other takes not identified above as a category.

Other Take (specify) h)